

Emissions of Black Carbon in California



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Black Carbon vs. Elemental Carbon

- Black carbon (BC)
 - the carbon component of particulate matter that absorbs light
- Elemental carbon (EC)
 - thermal optical analysis technique (operational definition)
- All of the inventory results in the current presentation are based on EC analysis using the NIOSH protocol

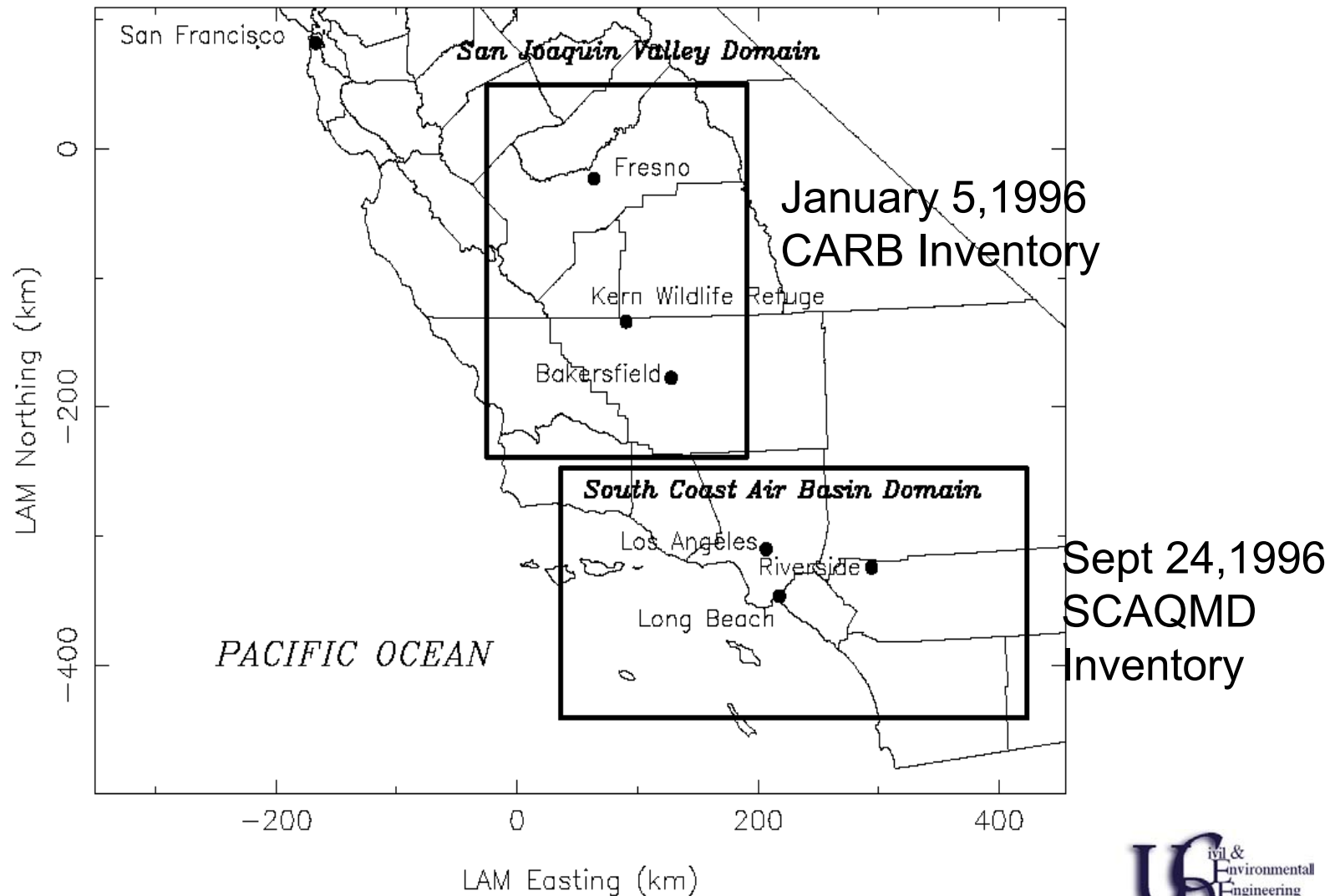


Environmental Impacts of EC

- Climate change
- Health effects
- Visibility reduction
- We need EC emissions inventories
 - Determine the effect of known processes
 - Identify important new processes

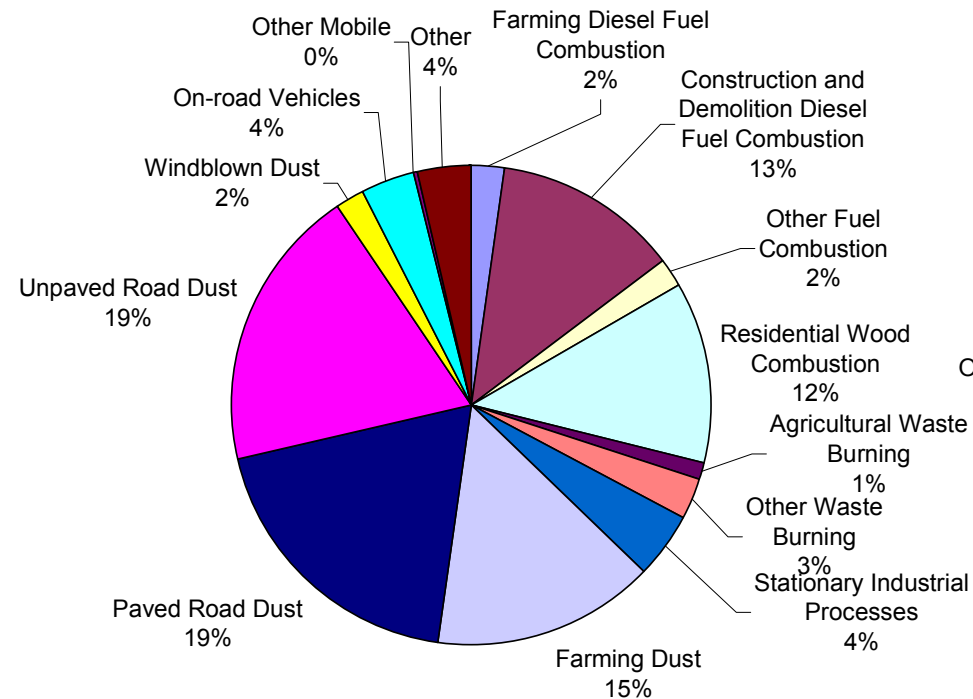


San Joaquin Valley and South Coast Air Basin

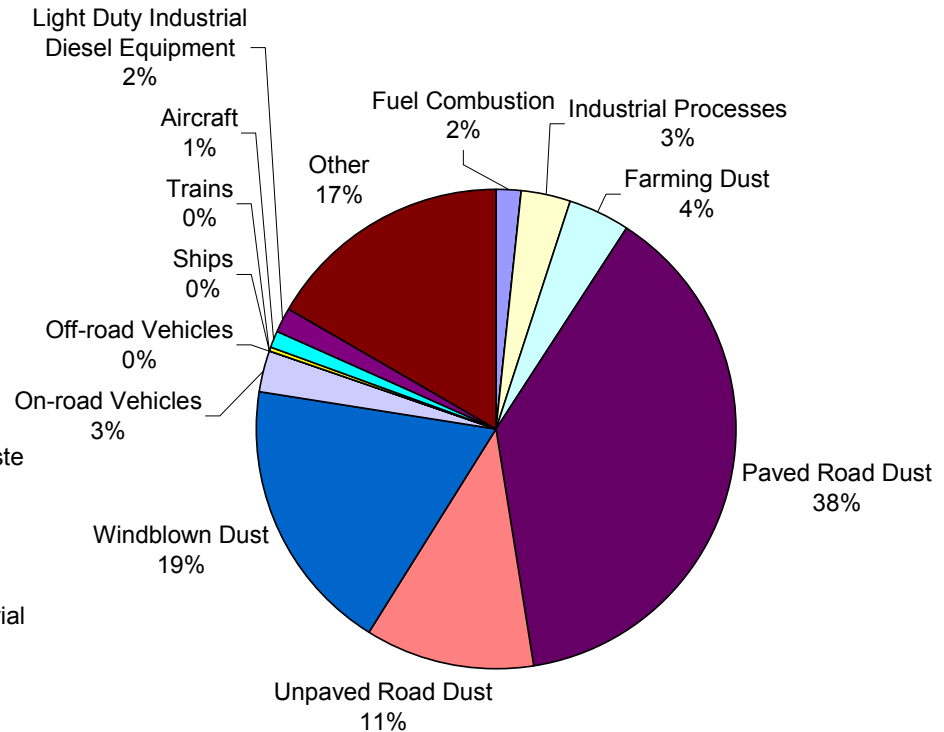


Summary of PM10 Mass Inventory

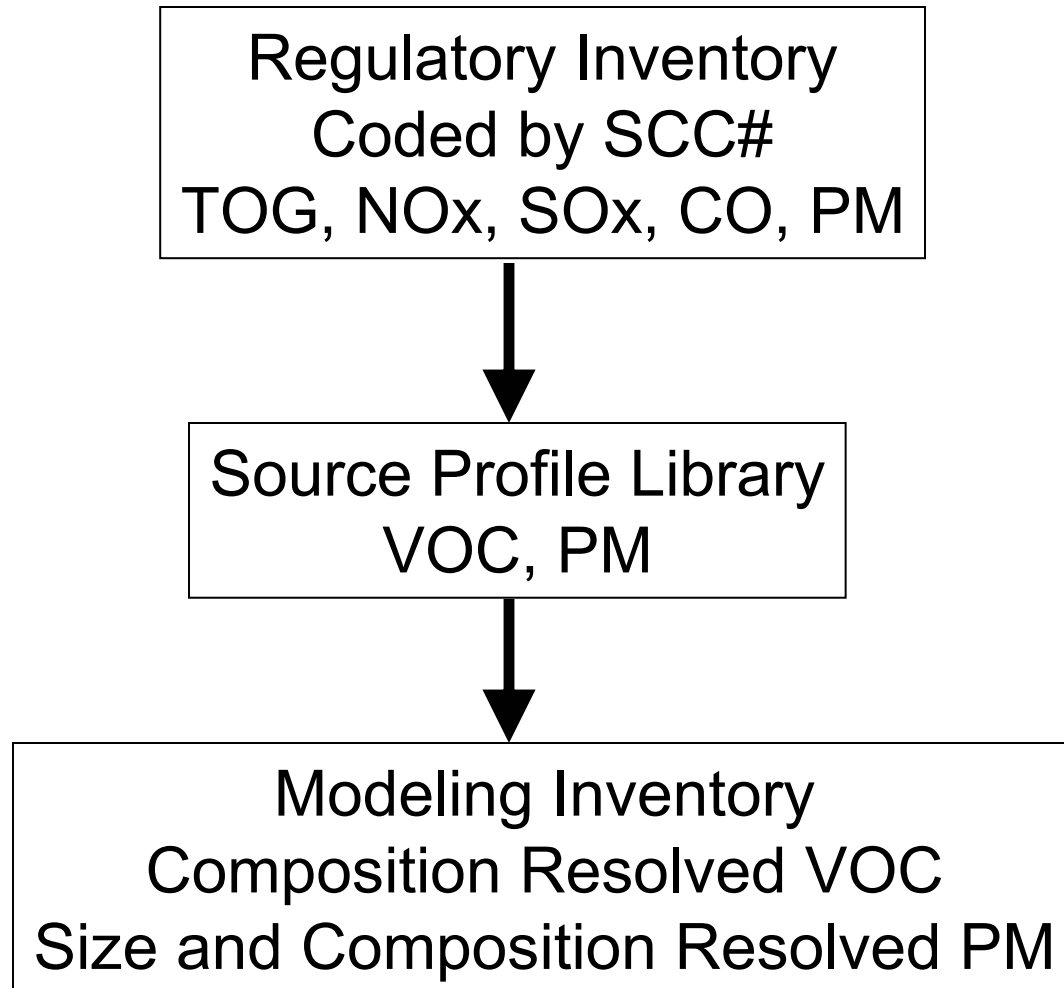
San Joaquin Valley (186.66 Tons/day)



Los Angeles (358.42 Tons/day)

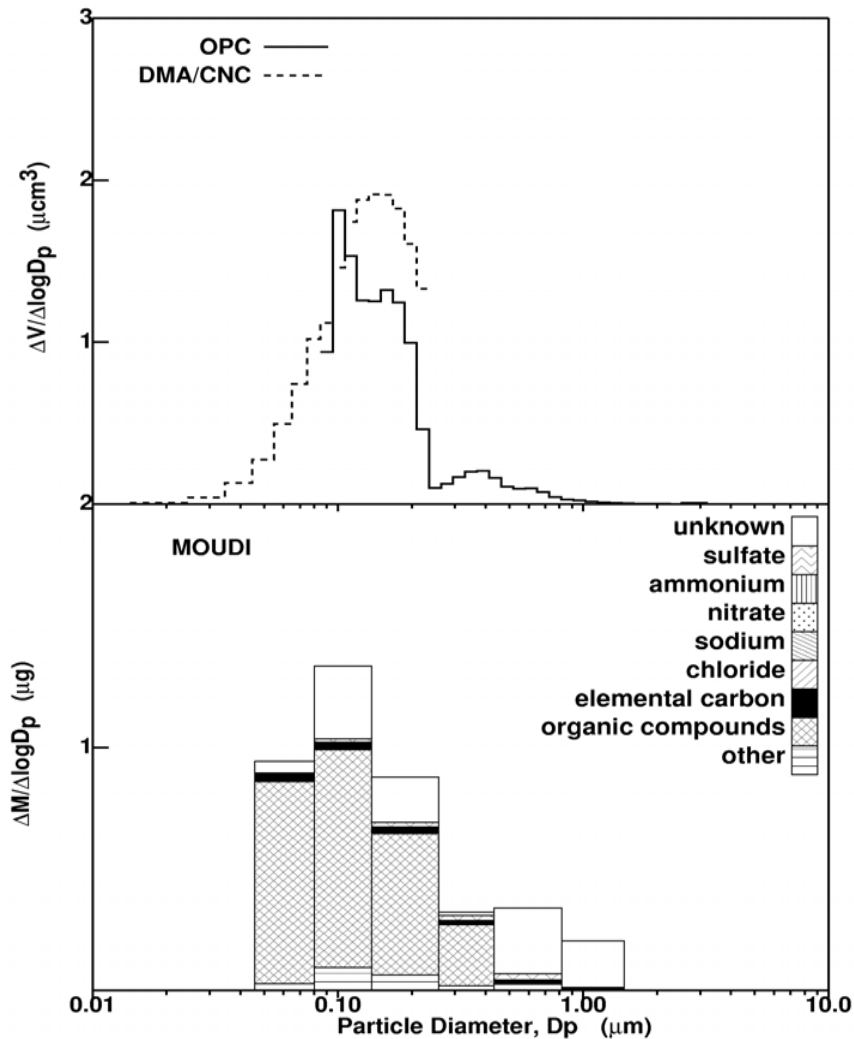


Conversion to Modeling Inventory

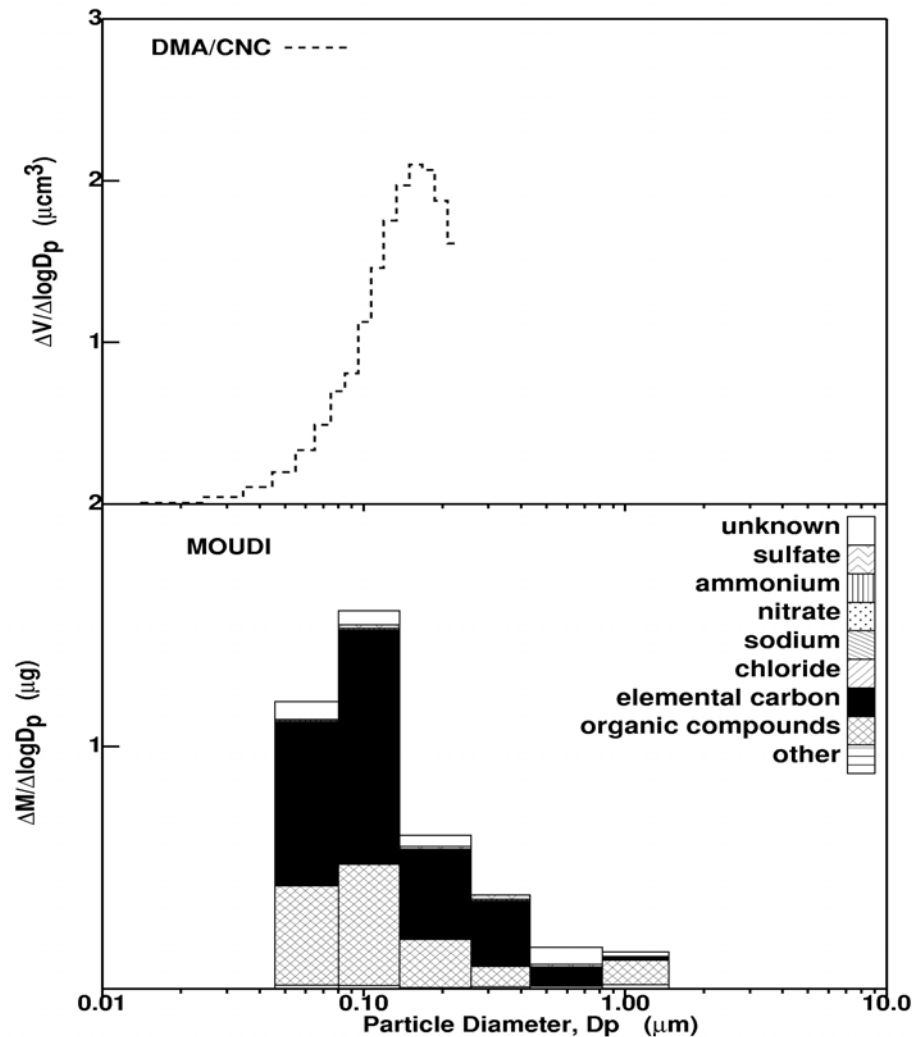


What is a PM Source Profile?

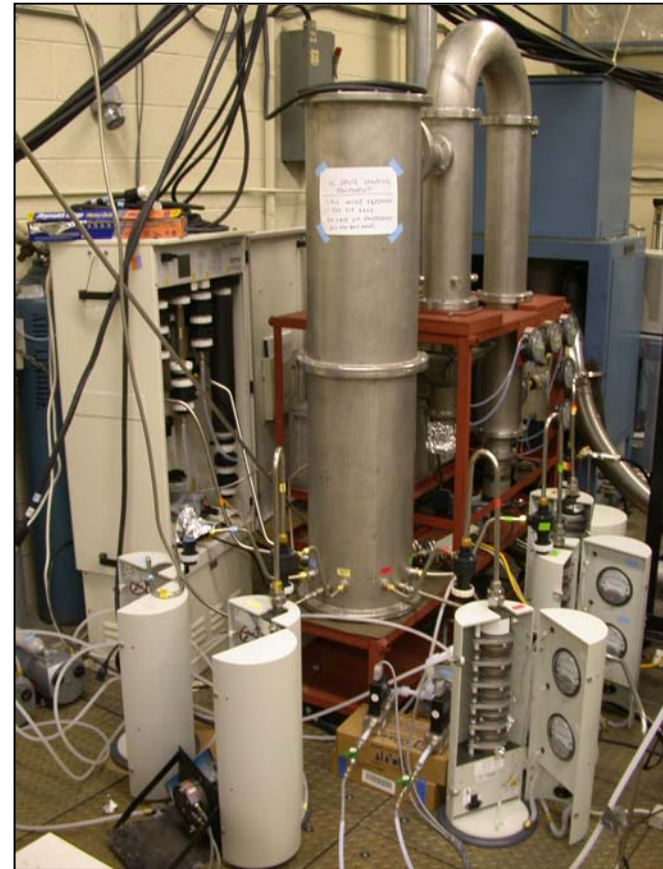
Catalyst-equipped Gasoline Vehicles



Medium Duty Diesel Vehicles



How Do You Measure a PM Source Profile?



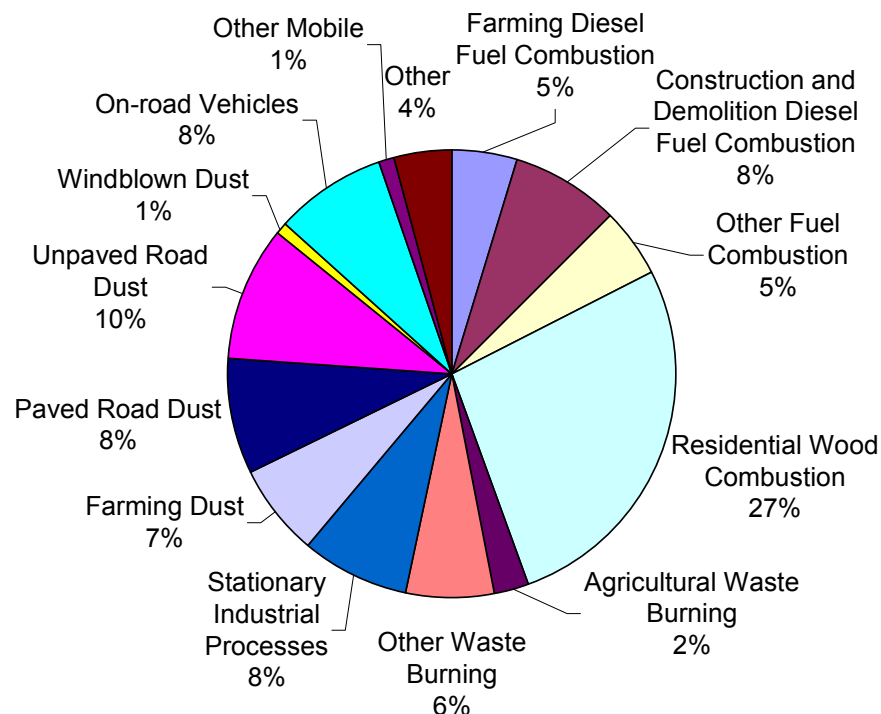
Which PM Profiles Exist?

- In Progress with Impactors (Schauer, Kleeman)
 - Heavy duty diesel engines, gasoline engines (catalyst and non-catalyst), brake wear, biomass combustion
- < 1998 with Impactors (Kleeman, Schauer, Cass)
 - Medium duty diesel engines, gasoline engines (catalyst and non-catalyst), wood smoke, meat cooking, cigarettes
- < 1990 with Filters and SMPS (Hildemann, Cass)
 - Natural gas boilers
- Older profiles
 - Cooper et al., 1989
 - Taback et al., 1979

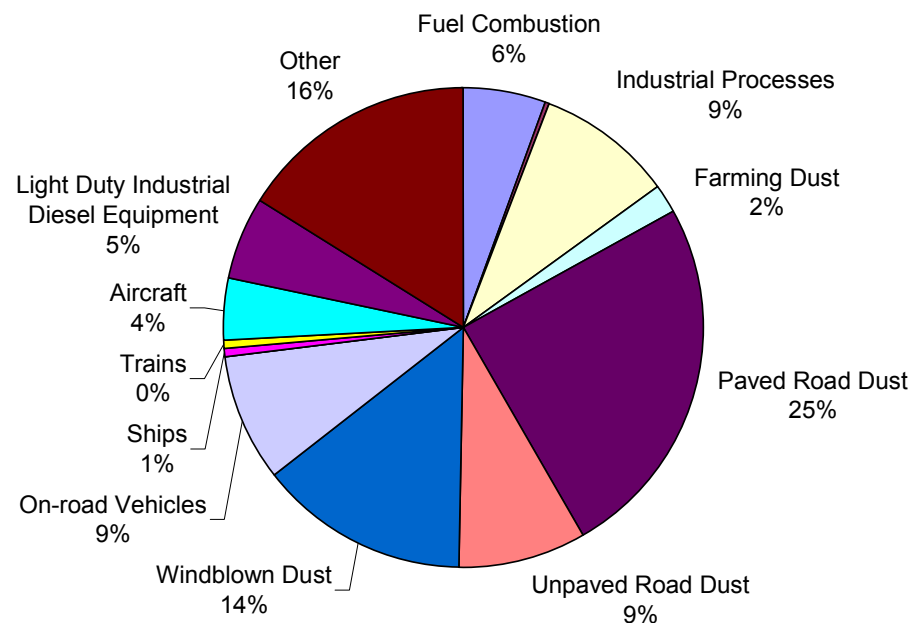


Summary of PM2.5 Mass Inventory

San Joaquin Valley (80.42 Tons/day)



Los Angeles (103.83 Tons/day)



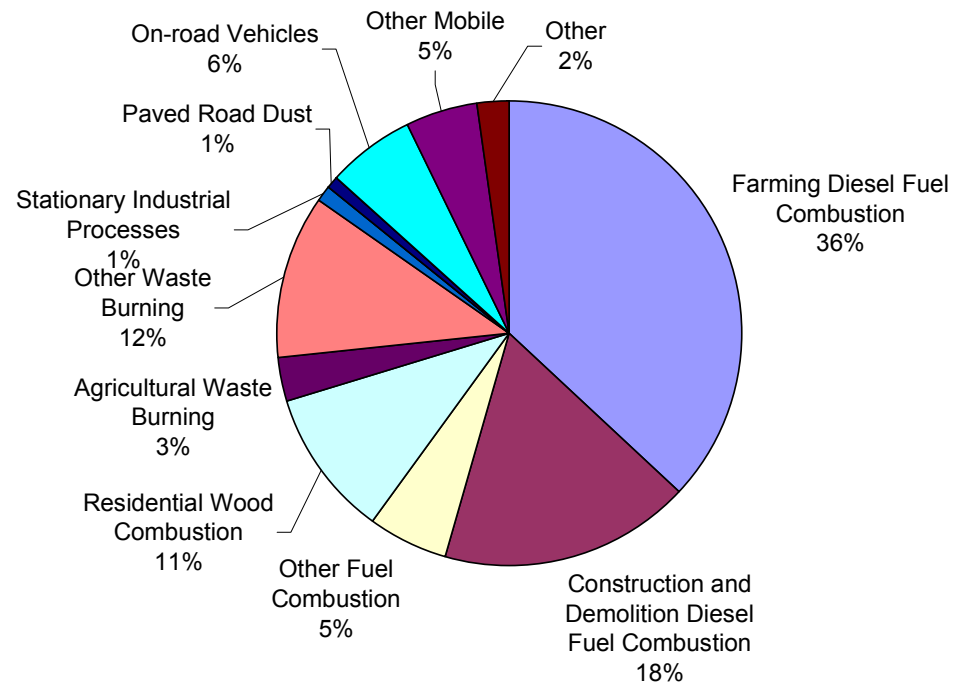
Inventory source: CARB

Inventory source: SCAQMD



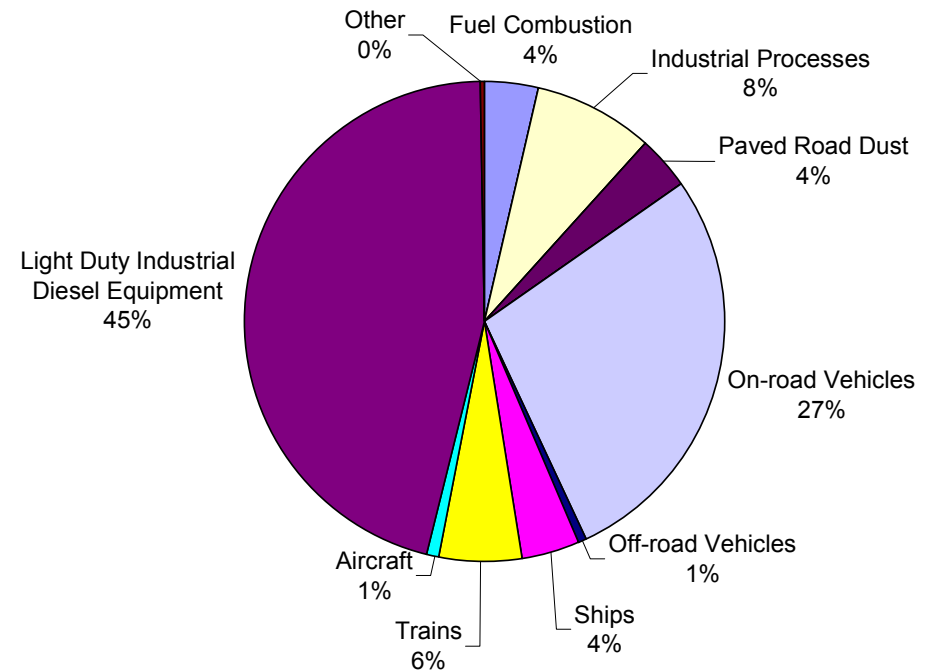
Summary of PM2.5 EC Inventory

San Joaquin Valley (8.21 Tons/day)



Inventory source: CARB

Los Angeles (7.31 Tons/day)

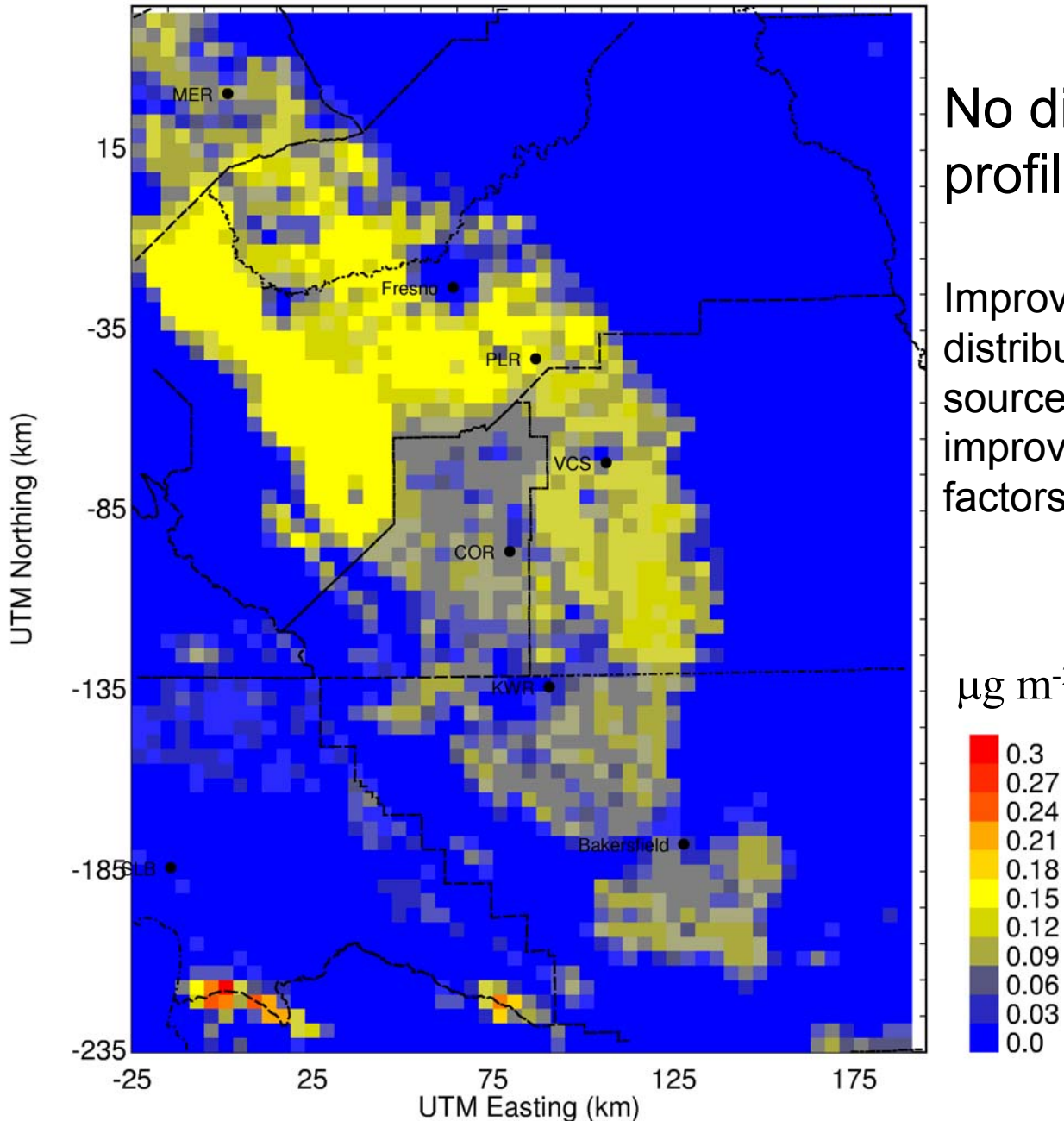


Inventory source: SCAQMD



Farm Diesel January 5, 1996

San Joaquin Valley

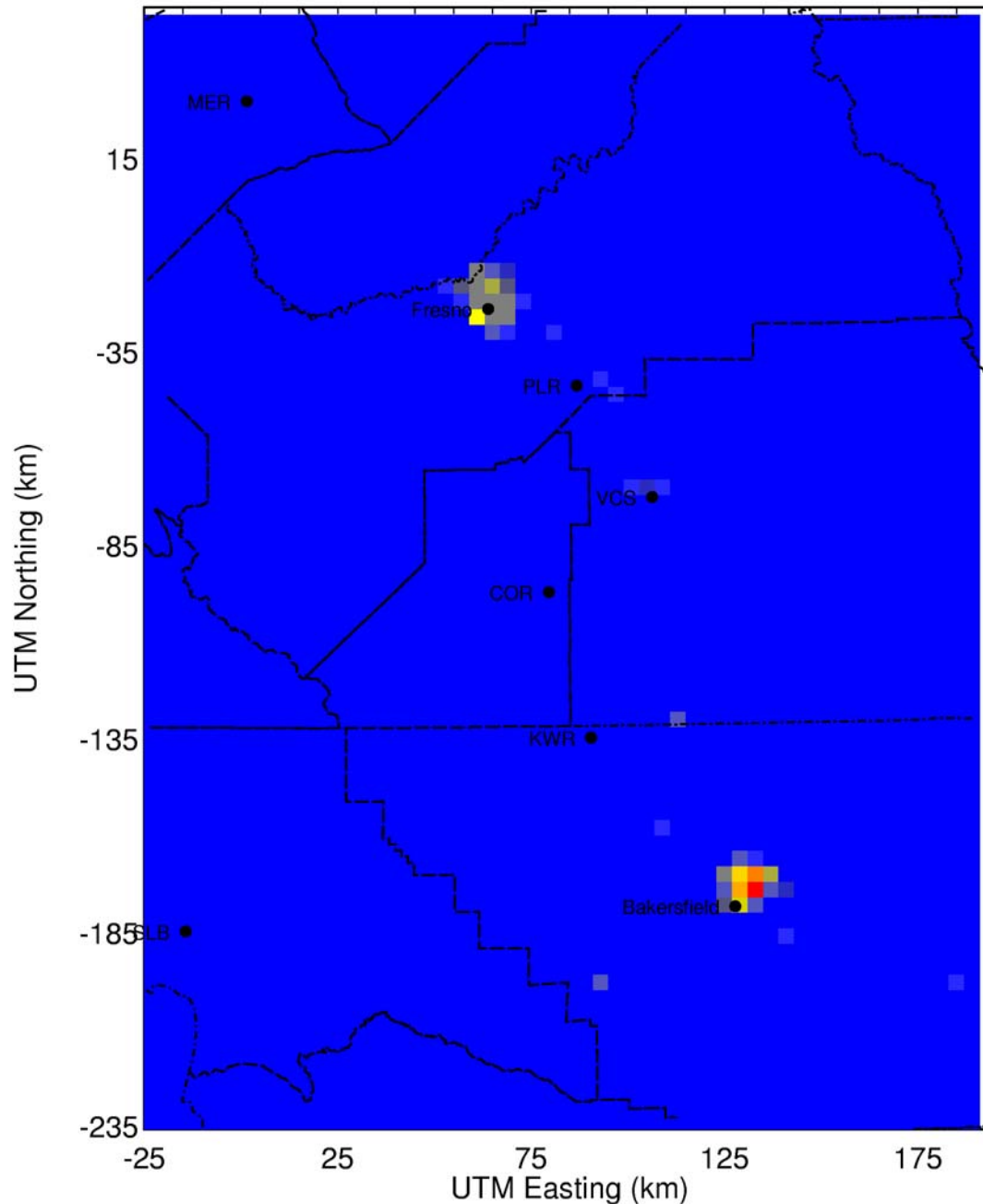


No diurnal profile.

Improved spatial distribution, additional source testing (and improved activity factors?) are needed.



San Joaquin Valley



No diurnal profile.

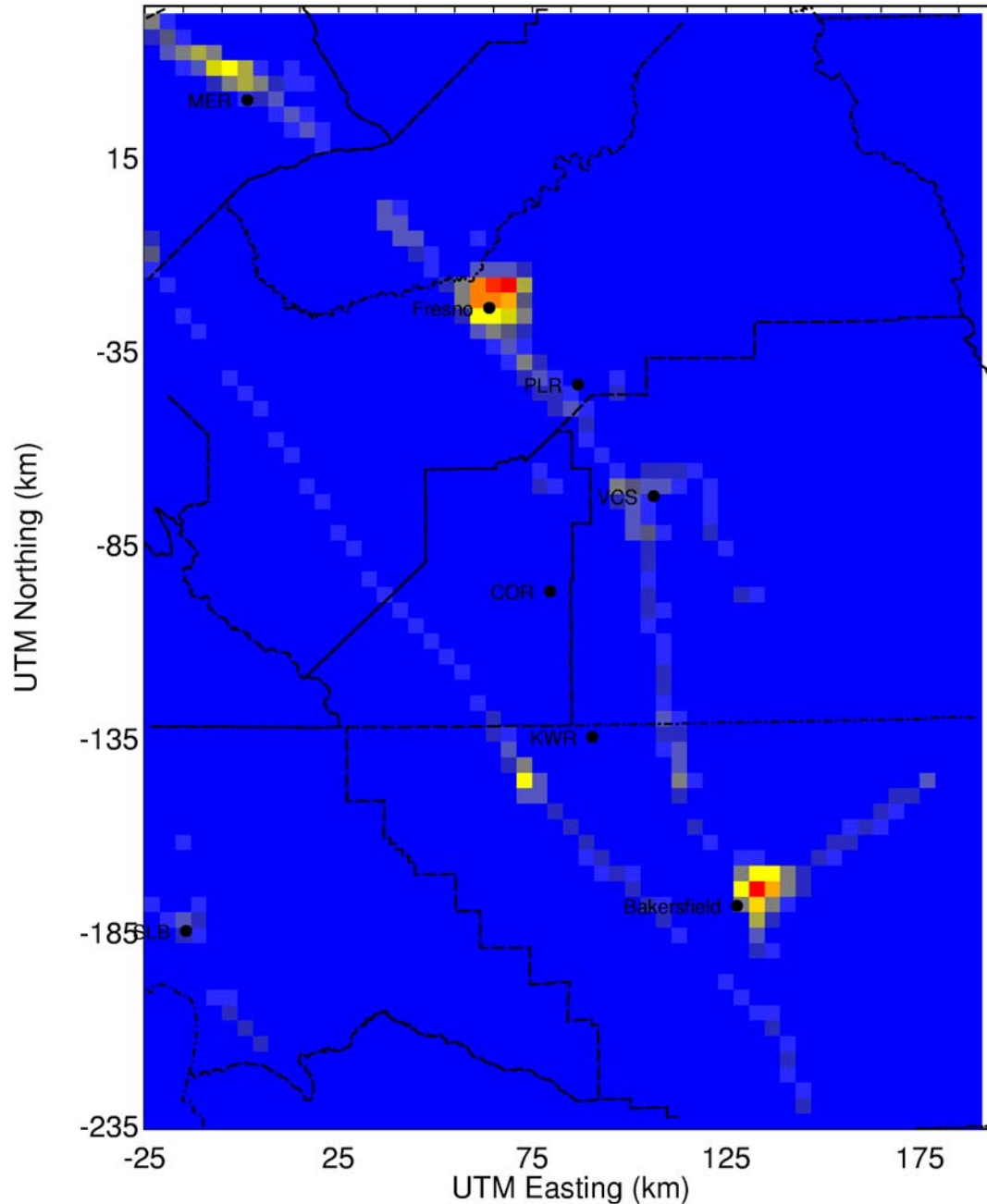
Improved spatial distribution, additional source testing (and improved activity factors?) are needed.

$\mu\text{g m}^{-2} \text{ min}^{-1}$



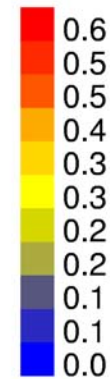
San Joaquin Valley

On Road Diesel January 5, 1996 7 PST



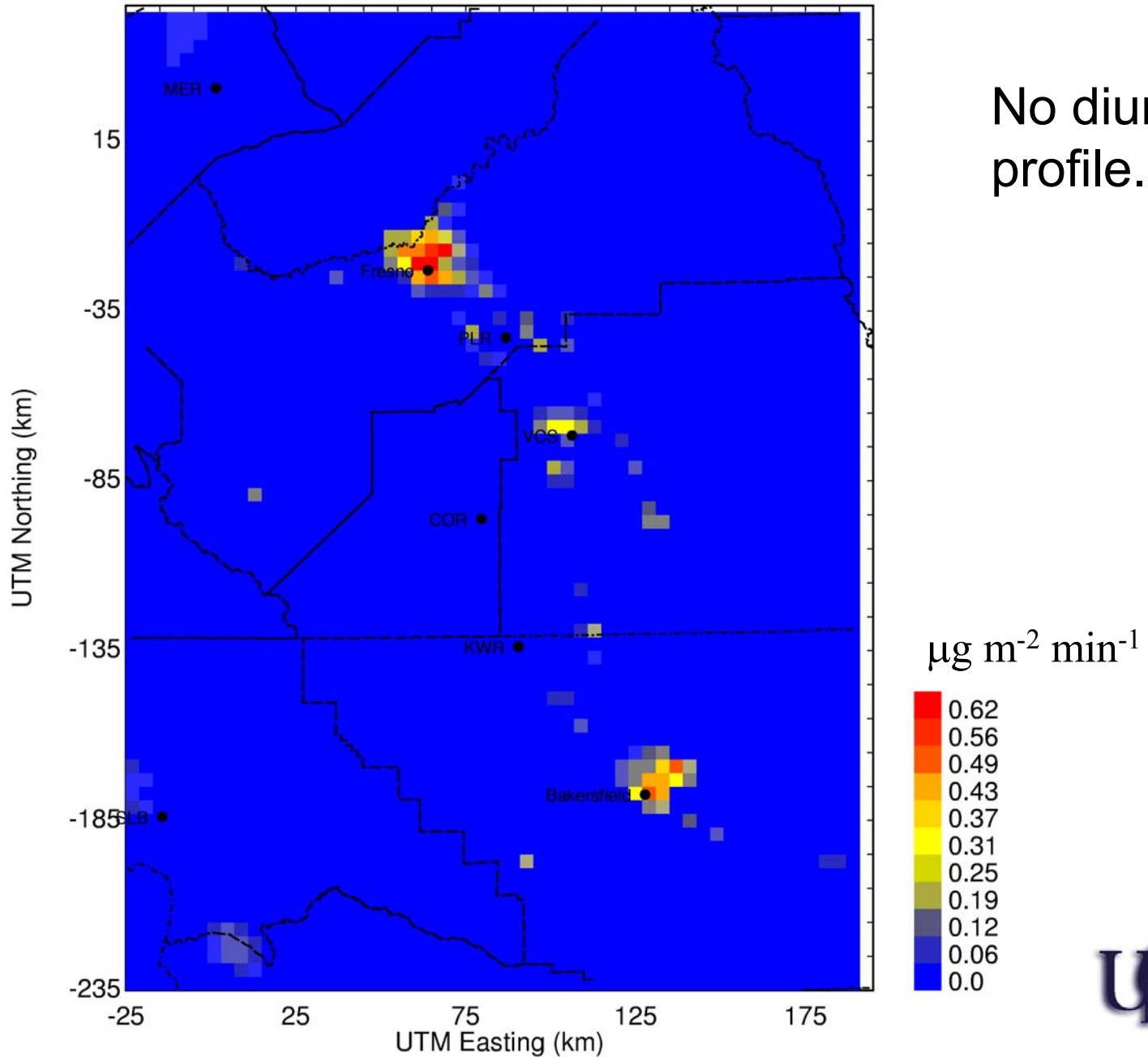
Constant
fraction of
LDV traffic.

$\mu\text{g m}^{-2} \text{ min}^{-1}$



San Joaquin Valley

Wood Burning January 5, 1996

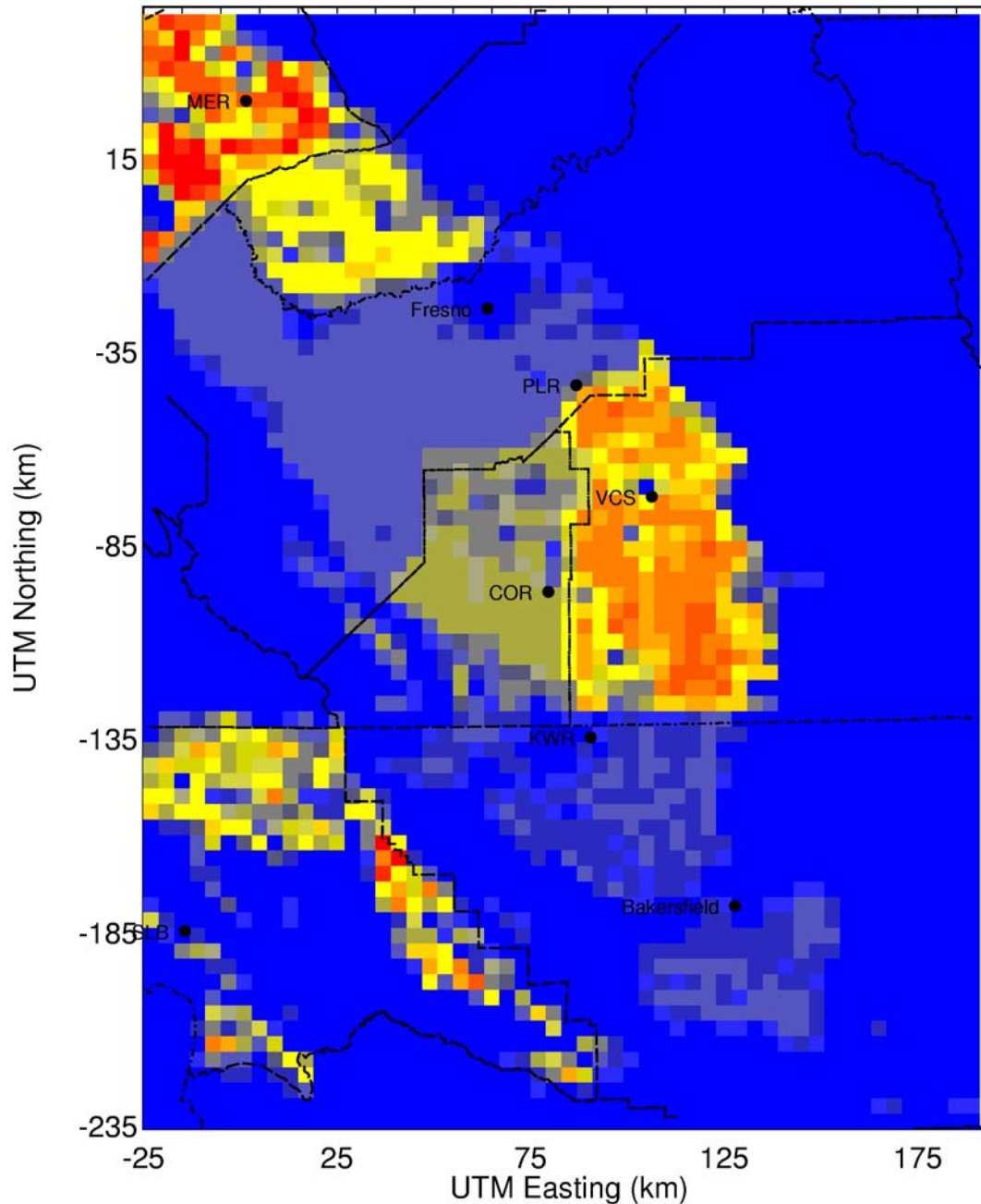


No diurnal profile.



Agricultural Waste Burning January 5, 1996

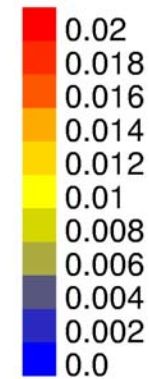
San Joaquin Valley



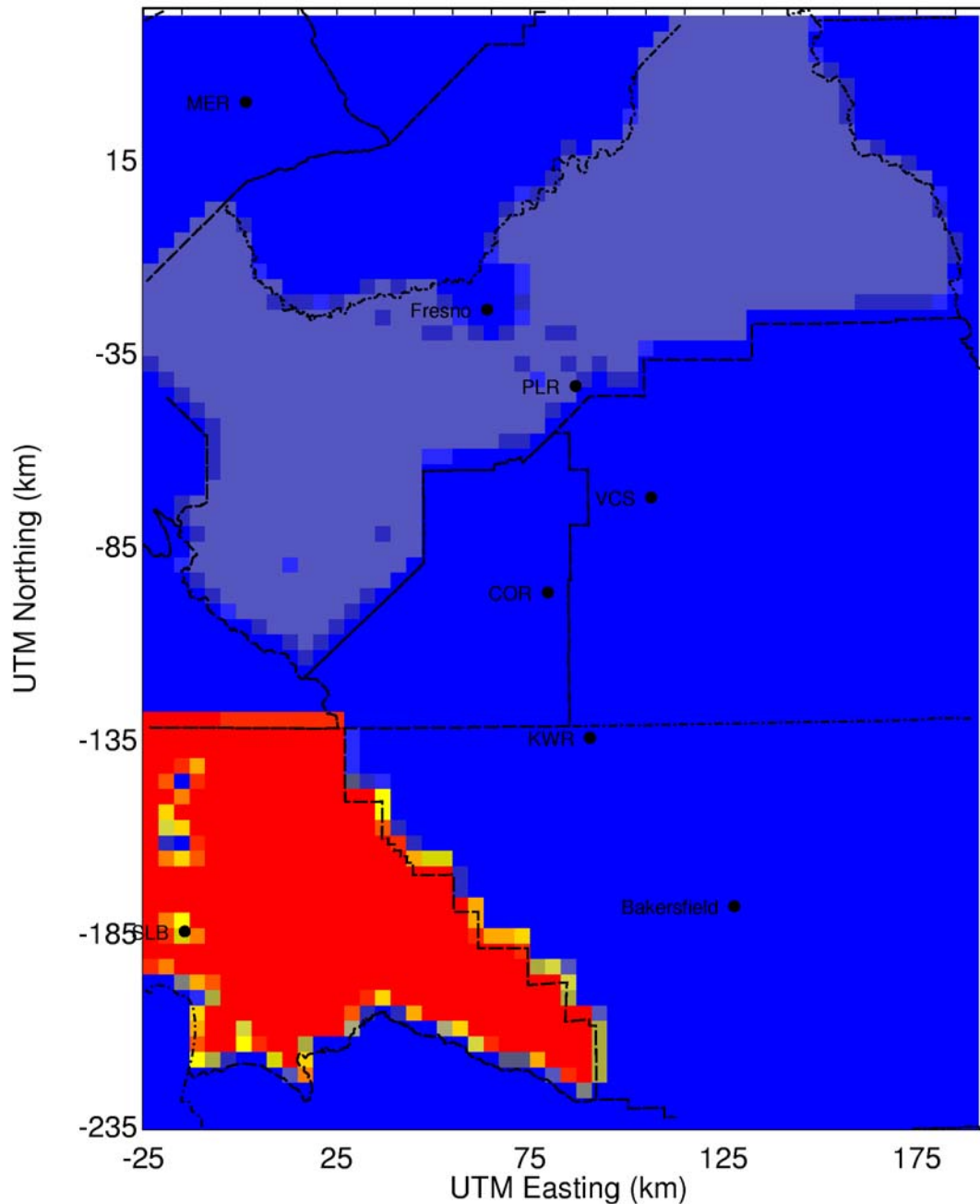
No diurnal profile.

Changes along county lines look artificial.

$\mu\text{g m}^{-2} \text{ min}^{-1}$



San Joaquin Valley



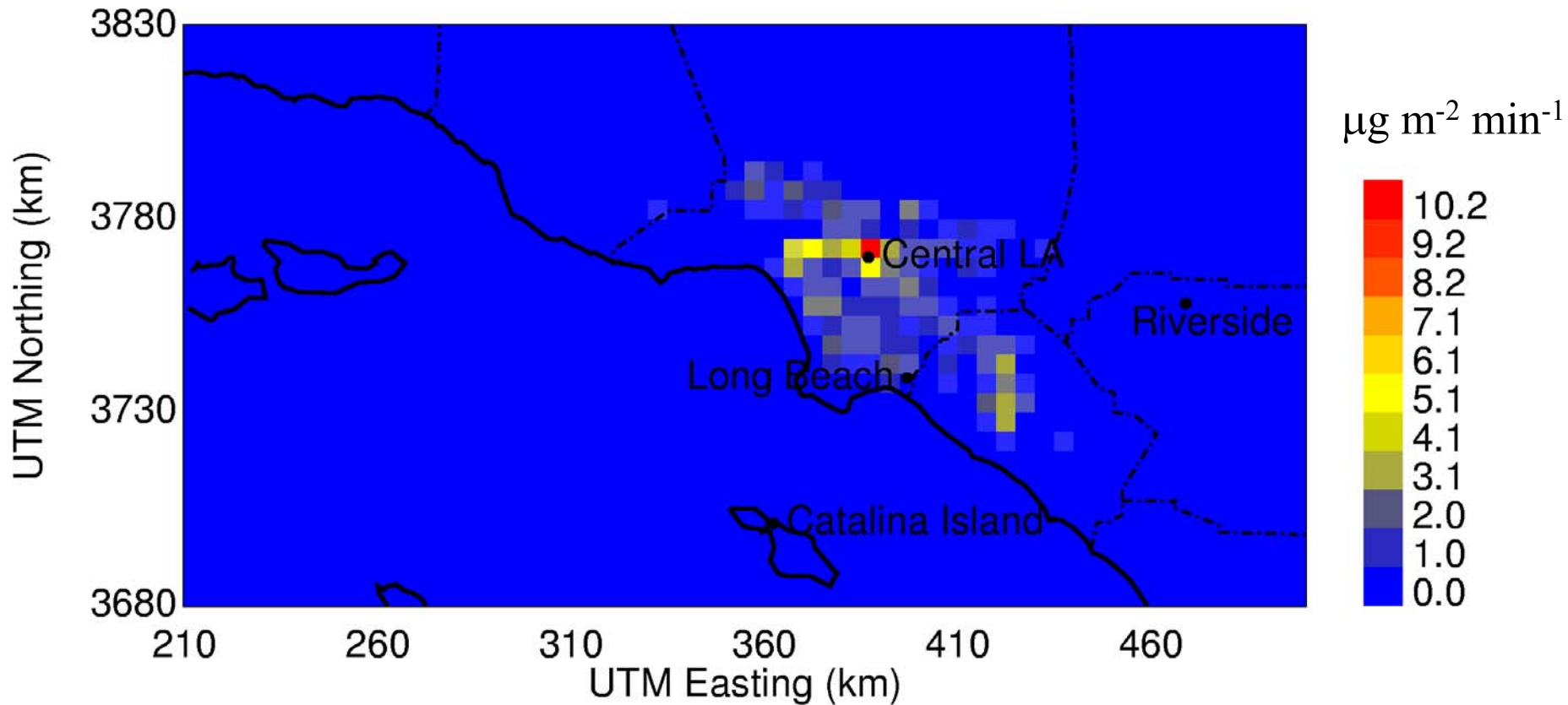
No diurnal profile.

Changes along county lines look artificial.



South Coast Air Basin

Light Duty Industrial Diesel September 24, 1996

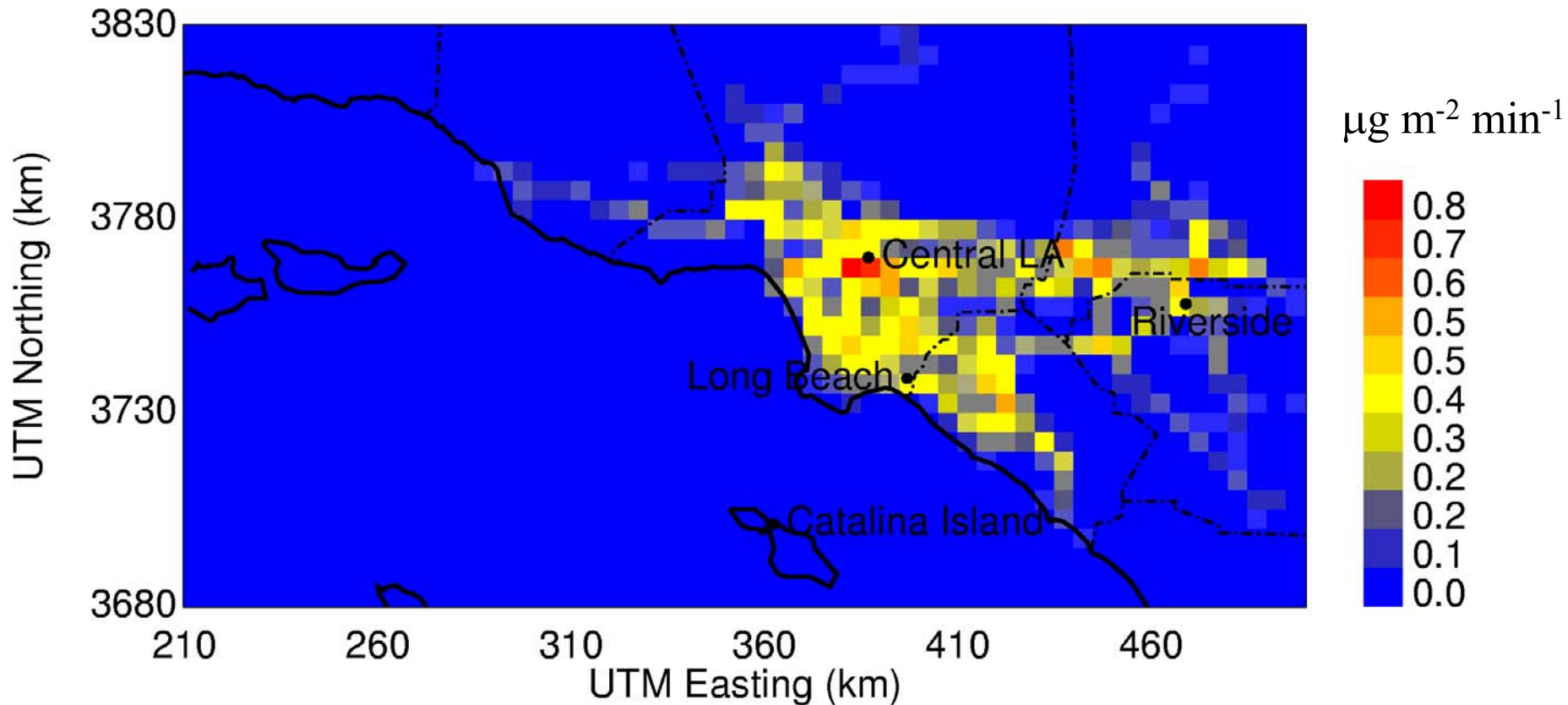


Constant activity from 9-15PST.



South Coast Air Basin

On Road Diesel September 24, 1996



Constant fraction of LDV traffic.



Summary of EC Emissions

- San Joaquin Valley (January 1996)
 - Major sources are agricultural diesel engines, construction and demolition diesel engines, on-road diesel engines, biomass burning
 - Accuracy of spatial distribution is uncertain
 - Temporal profiles are wrong
 - Accuracy of emissions factors and source profiles is uncertain for off-road sources
- South Coast Air Basin (September 1996)
 - Major sources are light duty industrial diesel engines and on-road diesel engines
 - Accuracy of spatial distribution is uncertain



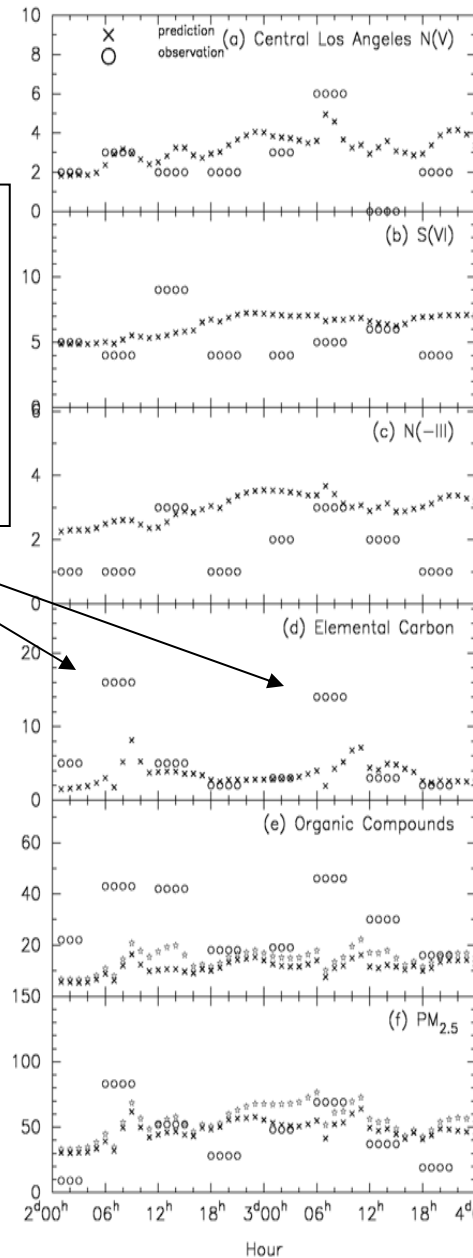
Does it Matter? It Depends on the Question!

- Systematic biases always matter
- Problems with spatial and diurnal profiles may not be important
 - Spatial distribution is less important as we move further from the source
 - Diurnal profile is less important as time passes

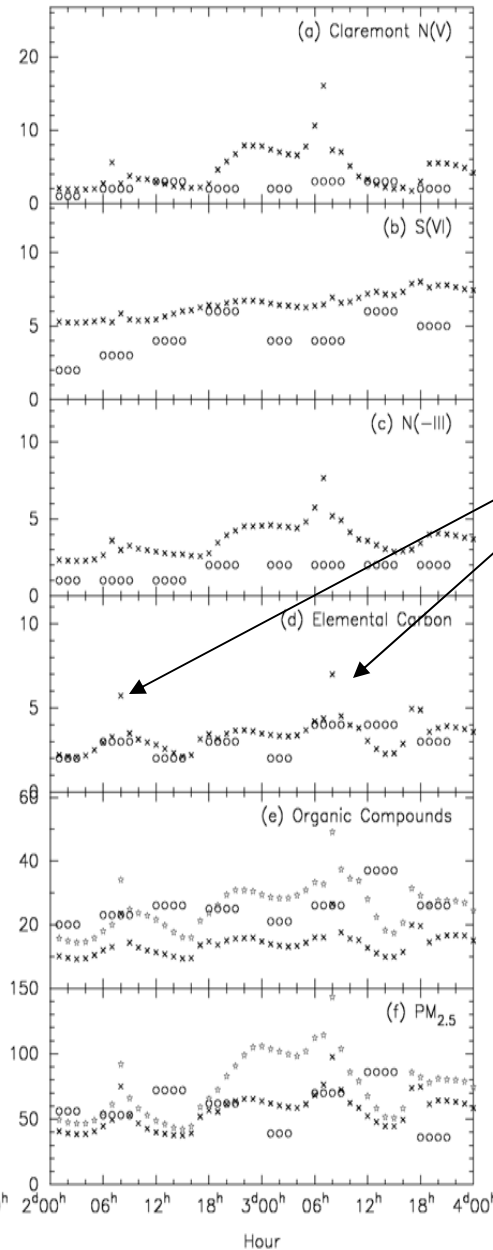


Regional Air Quality Predictions

EC is consistently under predicted during morning rush hour at central LA.



EC is slightly over predicted at Claremont.

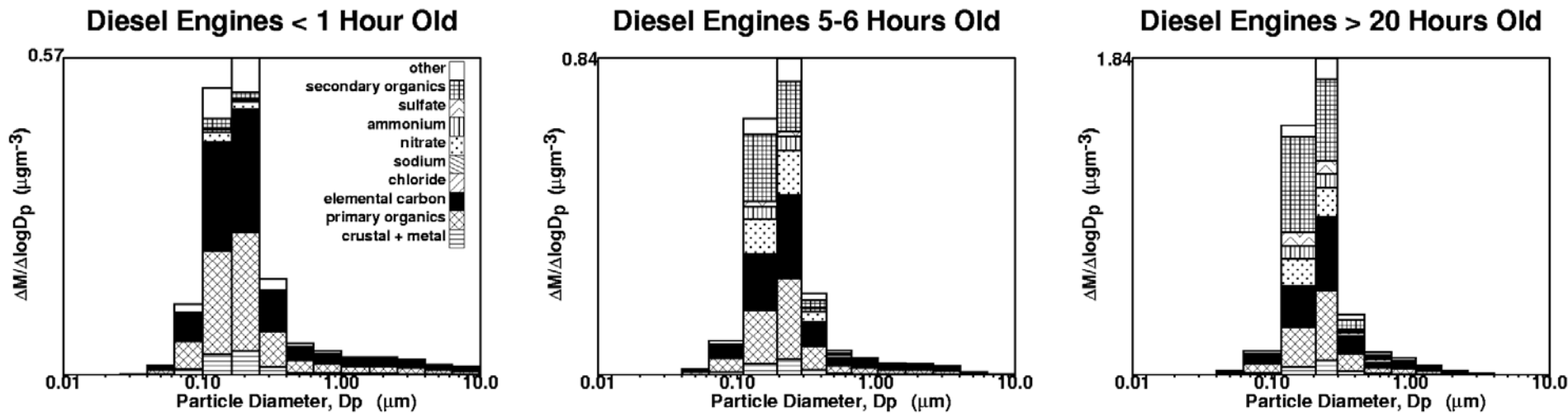


Areas to Strengthen

- Spatial and temporal distribution of area sources need to be verified
 - Agricultural diesel, biomass burning
- Emission rate and PM profiles for off-road sources need to be verified
- Realistic on-road heavy duty diesel emissions model needs to be developed
 - HDD as a fixed fraction of LDV is probably wrong
 - Need better spatial and temporal patterns



A Final Thought: Evolution of Particles in the Atmosphere



Acknowledgements

- California Air Resources Board
- South Coast Air Quality Management District

